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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/757,228

01/14/2004

Nishant Sinha

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3253

7590

11/24/2004

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EXAMINER

WILSON, CHRISTIAN D

ART UNIT

PAPER NUMBER

2824

DATE MAILED: 11/24/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/757,228

Applicant(s)

SINHA, NISHANT

Examiner

Christian Wilson

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1,2 and 6-23 is/are rejected.
- 7) ☒ Claim(s) 3-5 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 14 January 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____. |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>01142004</u> . | 6) <input checked="" type="checkbox"/> Other: <u>search history</u> . |

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1, 2, and 6 – 9 are rejected under 35 U.S.C. 102(e) as being anticipated by Hasunuma *et al.*

Hasunuma *et al.* (US 6,306,756) discloses a method of forming interconnects to a semiconductor device [Figure 18A-18D] comprising the steps of forming a first dielectric layer 7 over a base layer 9 of a semiconductor device, forming openings 6a to expose contact regions, positioning a conductive material 8b in the openings, forming a second dielectric layer 7' over the first dielectric layer, forming openings 6 extending through the second dielectric layer which extend from the upper surface of the second dielectric layer to the underlying conductive material, forming a malleable conductive layer 8 over the dielectric layer where the thickness of the conductive layer is less than the dielectric layer and lines the opening and uppermost surface of the dielectric layer [Figure 2D], and moving a portion of the malleable conductive layer [Figure 8] into the unfilled void to plug the opening [column 30, lines 35-45].

Regarding claim 2, Hasunuma *et al.* further discloses openings which are vertically aligned with openings in the first dielectric layer [Figure 18D].

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Regarding claim 6, Hasunuma *et al.* further discloses a silver malleable conductive layer [column 39, line 15-25].

Regarding claim 7, Hasunuma *et al.* further discloses a tungsten conductive material [column 37, line 46].

Regarding claims 8 and 9, Hasunuma *et al.* further discloses a silicon nitride first and second dielectric layer [column 16, line 39].

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 10 – 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hasunuma *et al.* in view of Kozicki.

Regarding claims 10 – 16, Hasunuma *et al.* teaches the limitations of claim 1 as described above, but does not discuss forming a chalcogenide device in the opening of the dielectric layer. Kozicki (US 6,487,106) teaches forming a chalcogenide device comprising removing a portion of the malleable conductive material [column 6, lines 55-56], depositing a chalcogenide 140, processing the device to dope the chalcogenide with the malleable conductive material [column 4, lines 60-65], removing the malleable conductive material by etching back [column 6, line 57], depositing the chalcogenide over the dielectric layer and malleable conductive material [Figure 1], polishing to remove the chalcogenide layer not formed in the unfilled void [column 7, line 4],

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doping by heating the device [column 5, line 58], forming a solid solution [column 5, line 53], and forming a chalcogenide of selenium and germanium [column 5, line 45]. It would have been obvious to one of ordinary skill in the art to use the method of Hasunuma *et al.* to form the device of Kozicki since the method of Hasunuma *et al.* provides a low temperature for forming metal lines which does not deteriorate the semiconductor device [column 5, lines 60-65].

Regarding claims 17 – 23, Hasunuma *et al.* teaches a method of forming interconnects to a semiconductor device [Figure 18A-18D] comprising the steps of forming a first dielectric layer 7 over a base layer 9 of a semiconductor device, forming openings 6a to expose contact regions, positioning a conductive material 8b in the openings, forming a second dielectric layer 7' over the first dielectric layer, forming openings 6 extending through the second dielectric layer which extend from the upper surface of the second dielectric layer to the underlying conductive material, forming a malleable conductive layer 8 over the dielectric layer where the thickness of the conductive layer is less than the dielectric layer and lines the opening and uppermost surface of the dielectric layer [Figure 2D], and moving a portion of the malleable conductive layer [Figure 8] into the unfilled void to plug the opening [column 30, lines 35-45]. Hasunuma *et al.* does not discuss forming a chalcogenide device in the opening of the dielectric layer. Kozicki teaches forming a chalcogenide device comprising removing a portion of the malleable conductive material [column 6, lines 55-56], depositing a chalcogenide 140, processing the device to dope the chalcogenide with the malleable conductive material [column 4, lines 60-65], removing the malleable conductive material by etching back [column 6, line 57], depositing the chalcogenide over the dielectric layer and malleable conductive material [Figure 1], polishing to remove the chalcogenide layer not formed in the unfilled void [column 7, line 4], doping by

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heating the device [column 5, line 58], forming a solid solution [column 5, line 53], and forming a chalcogenide of selenium and germanium [column 5, line 45]. It would have been obvious to one of ordinary skill in the art to use the method of Hasunuma *et al.* to form the device of Kozicki since the method of Hasunuma *et al.* provides a low temperature for forming metal lines which does not deteriorate the semiconductor device [column 5, lines 60-65].

Allowable Subject Matter

5. Claims 3 – 5 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

6. The following is a statement of reasons for the indication of allowable subject matter: applicant discloses a novel method of moving the malleable conductive layer by polishing the layer.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The cited prior art teaches methods of filling vias with malleable conductive layers.

8. A copy of the search history (EAST and STN) is enclosed.

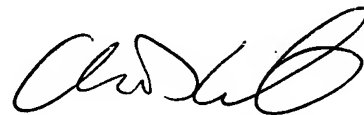
9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christian Wilson whose telephone number is (571) 272-1886.

The examiner can normally be reached on weekdays, 7:30 AM to 4 PM.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richard Elms can be reached on (571) 272-1869. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'Christian Wilson', is positioned above the printed name.

Christian Wilson, Ph.D.
Primary Examiner
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CDW